Analysis of AIRS 07/20/2002 Focus Data

Hank Revercomb, Dave Tobin, S. Chia Lee, Steve Ackerman,
Paolo Antonelli, Mat Gunshor, Bob Knuteson
CIMSS / SSEC / UW-Madison

- Noise Characterization using Earth scene data
- Cloud flag

AIRS Science Team Net-Meeting, 01 August 2002

NeDT estimation using Earth scene data

- **Approach:**

  Using all spectra from a granule:

  1) generate principle components (PCs) of the covariance matrix of the spectra within the granule.

  2) reconstruct the spectra using a reduced number of PCs, and

  3) use statistics of the reconstruction error to derive initial noise estimates

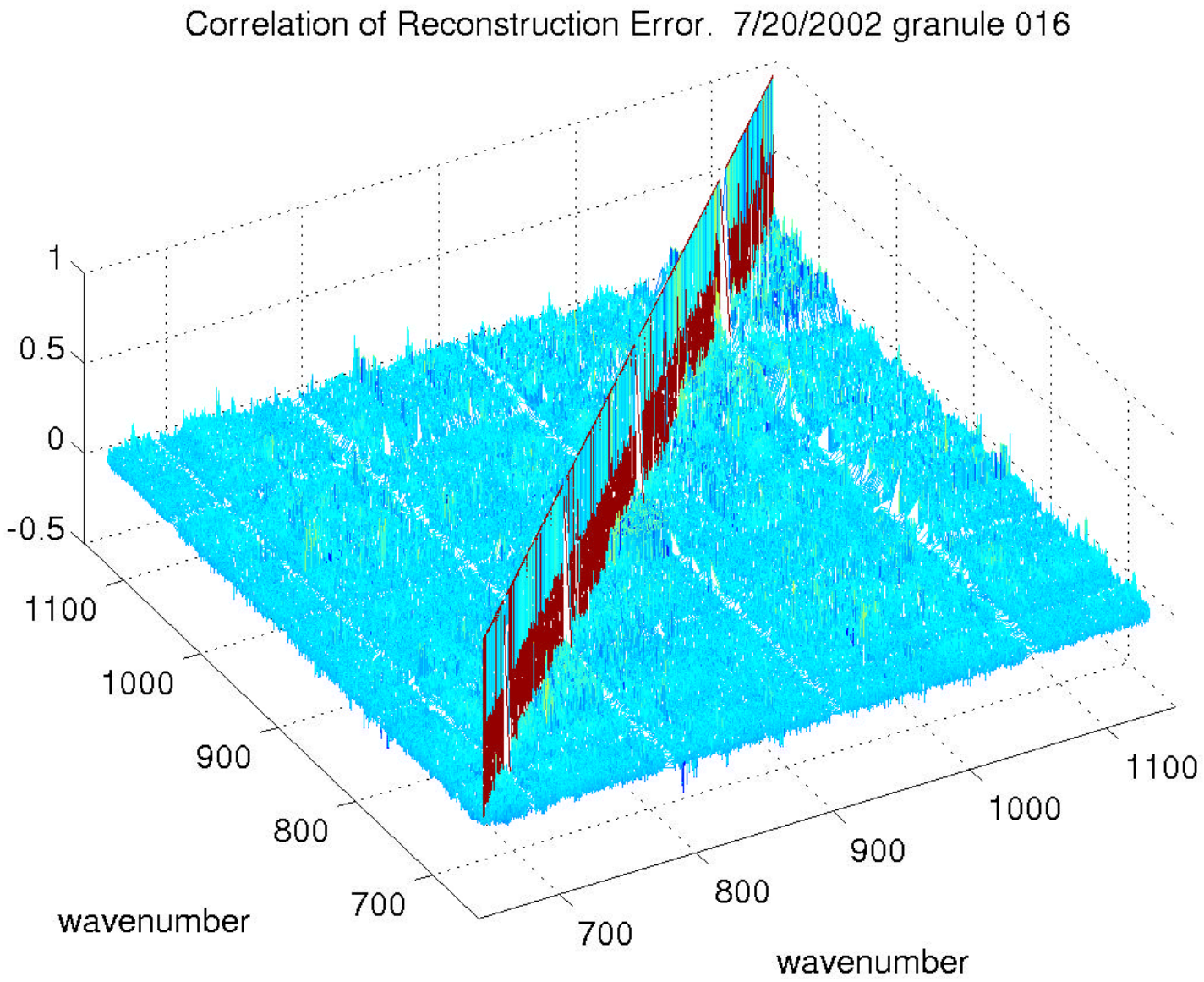
  4) Normalize spectra using initial noise estimate (divide by NeN)

  5) generate principle components (PCs) of the covariance matrix of the normalized spectra within the granule.

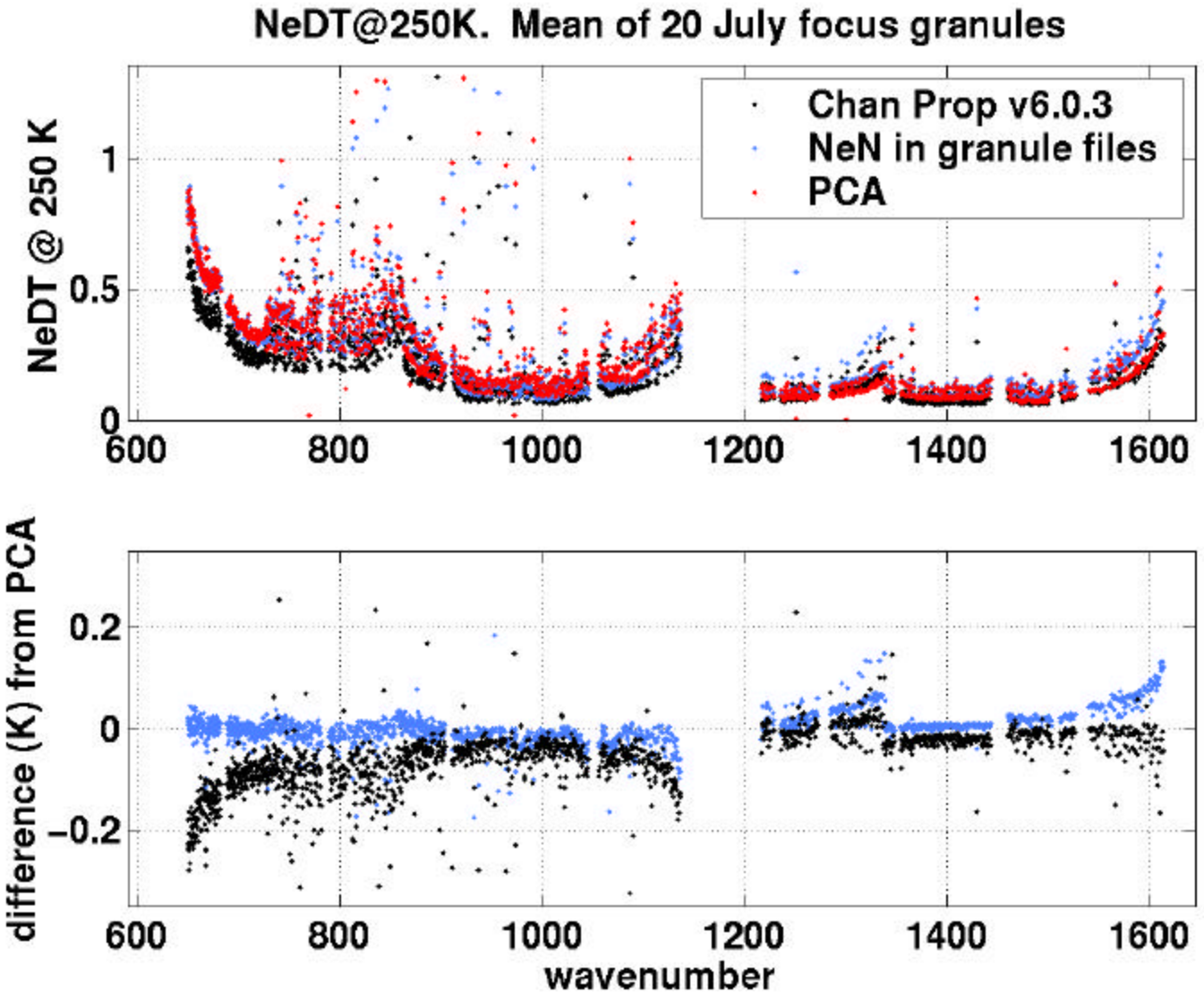
  6) reconstruct normalized spectra using a reduced number of PCs, and

  7) Remove normalization (multiply spectra by the initial noise estimate) and use statistics of the reconstruction error to derive noise estimates

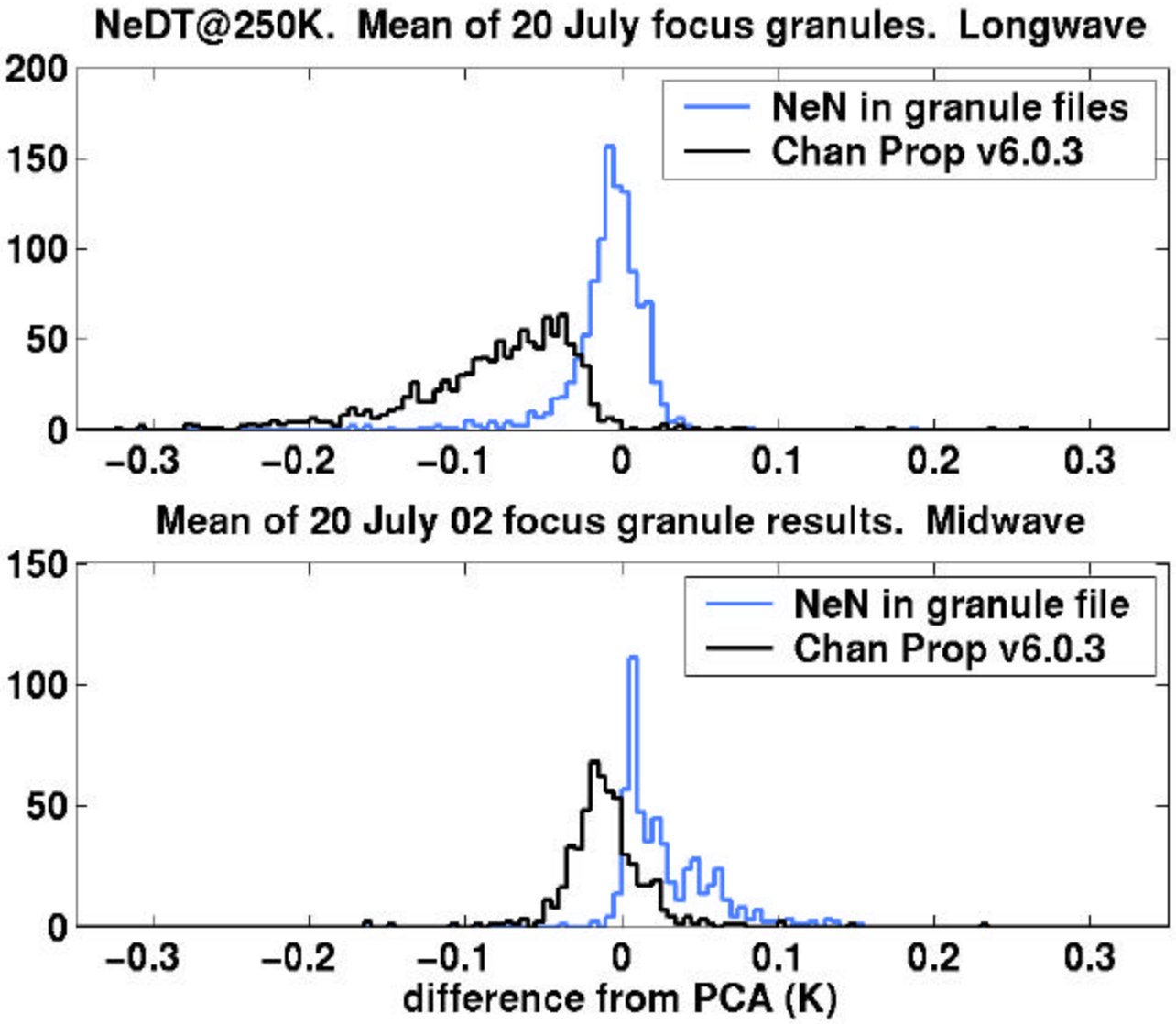
Correlation of Reconstruction Difference



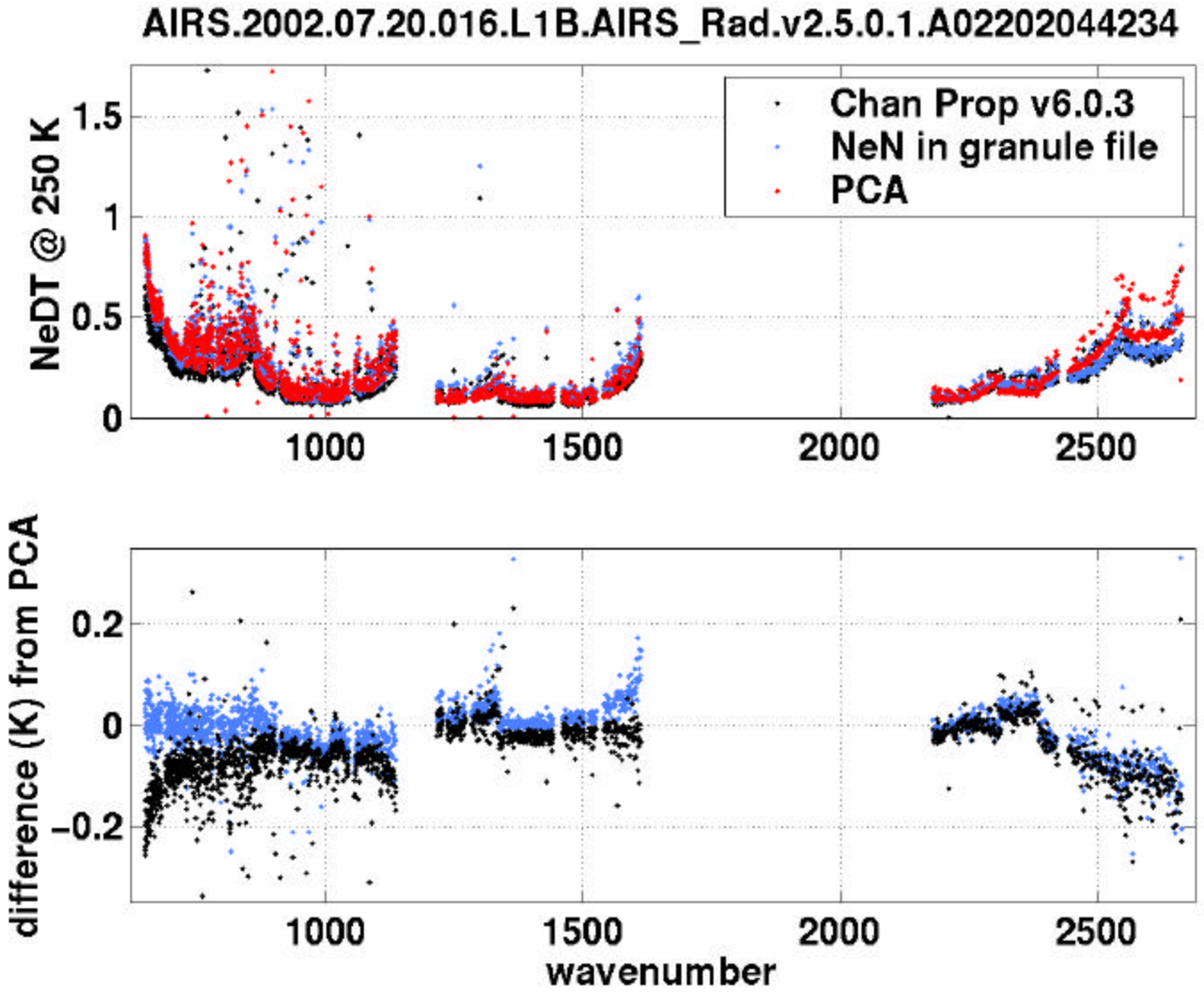
Mean of 7/20 Focus Granule Results



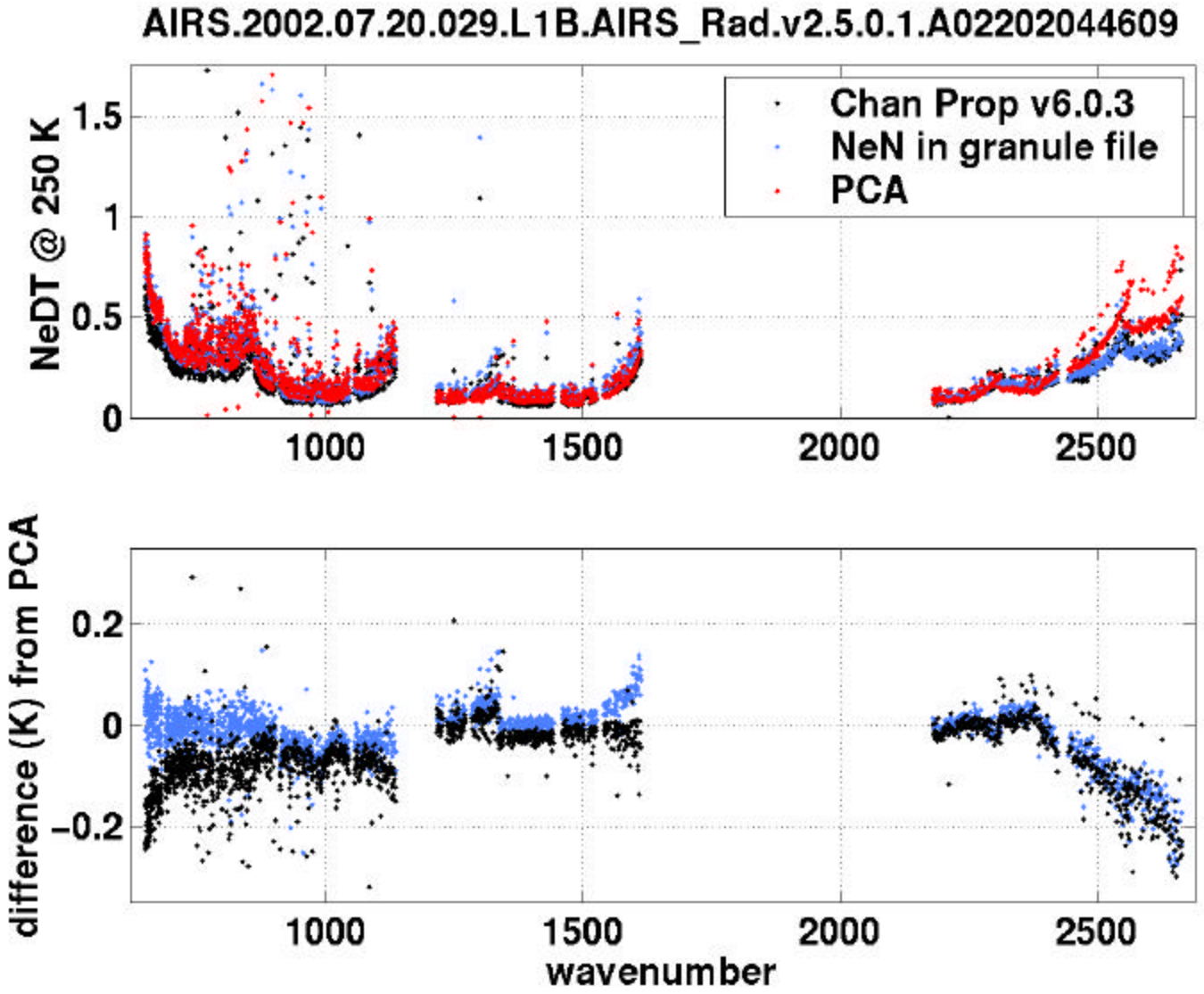
Mean of 7/20 Focus Granule Results



granule 016


AIRS.2002.07.20.016.L1B.AIRS_Rad.v2.5.0.1.A02202044234
Chan Prop v6.0.3
NeN in granule file
PCA
NeDT @ 250 K
1.5
1
0.5
0
1000
1500
2000
2500
difference (K) from PCA
0.2
0
−0.2
1000
1500
2000
2500
wavenumber

granule 029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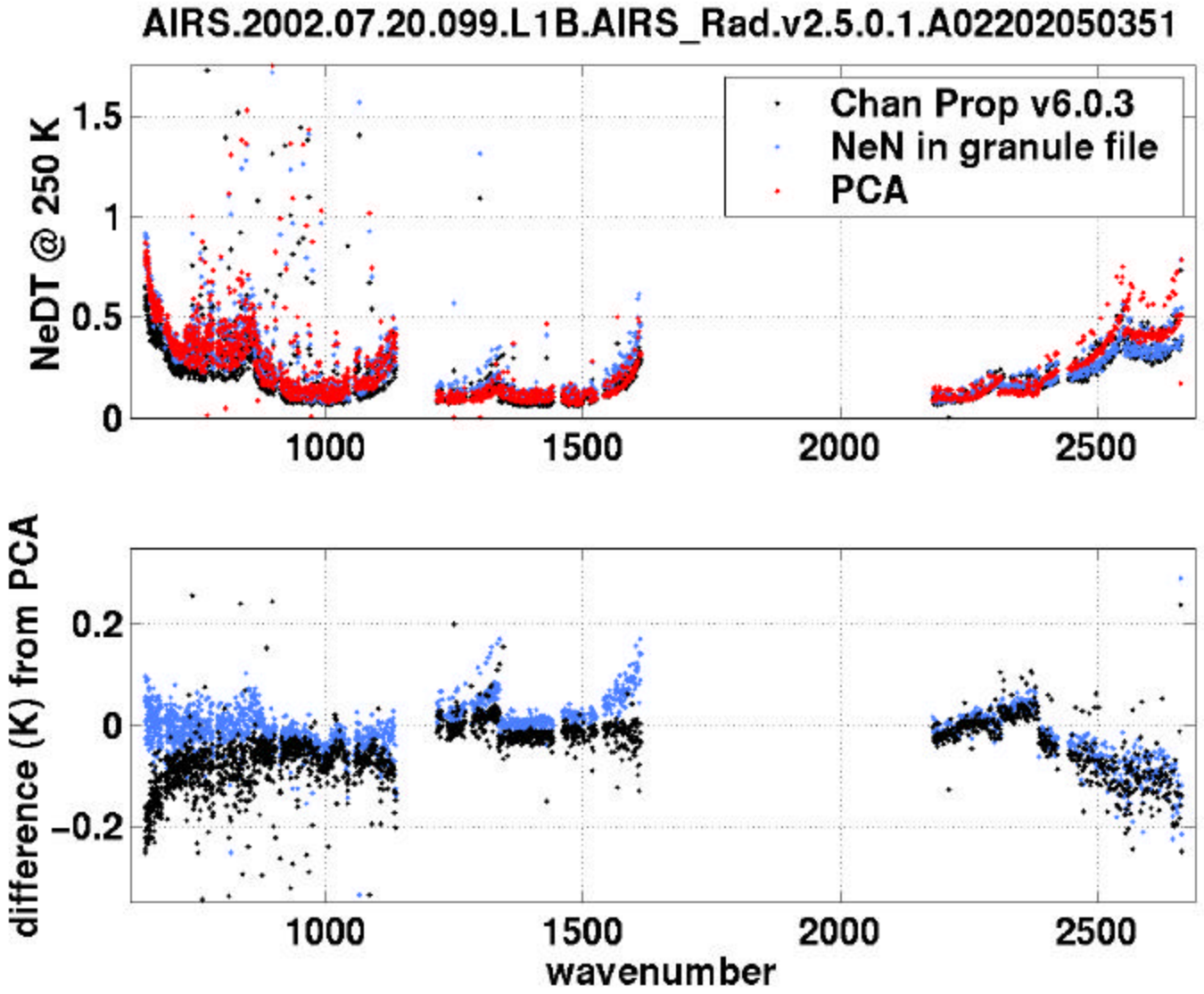
Chan Prop v6.0.3
NeN in granule file
PCA
NeDT @ 250 K
1.5
1
0.5
0
1000
1500
2000
2500
difference (K) from PCA
0.2
0
−0.2
1000
1500
2000
2500
wavenumber

granule 099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Chan Prop v6.0.3
NeN in granule file
PCA
NeDT @ 250 K
1.5
1
0.5
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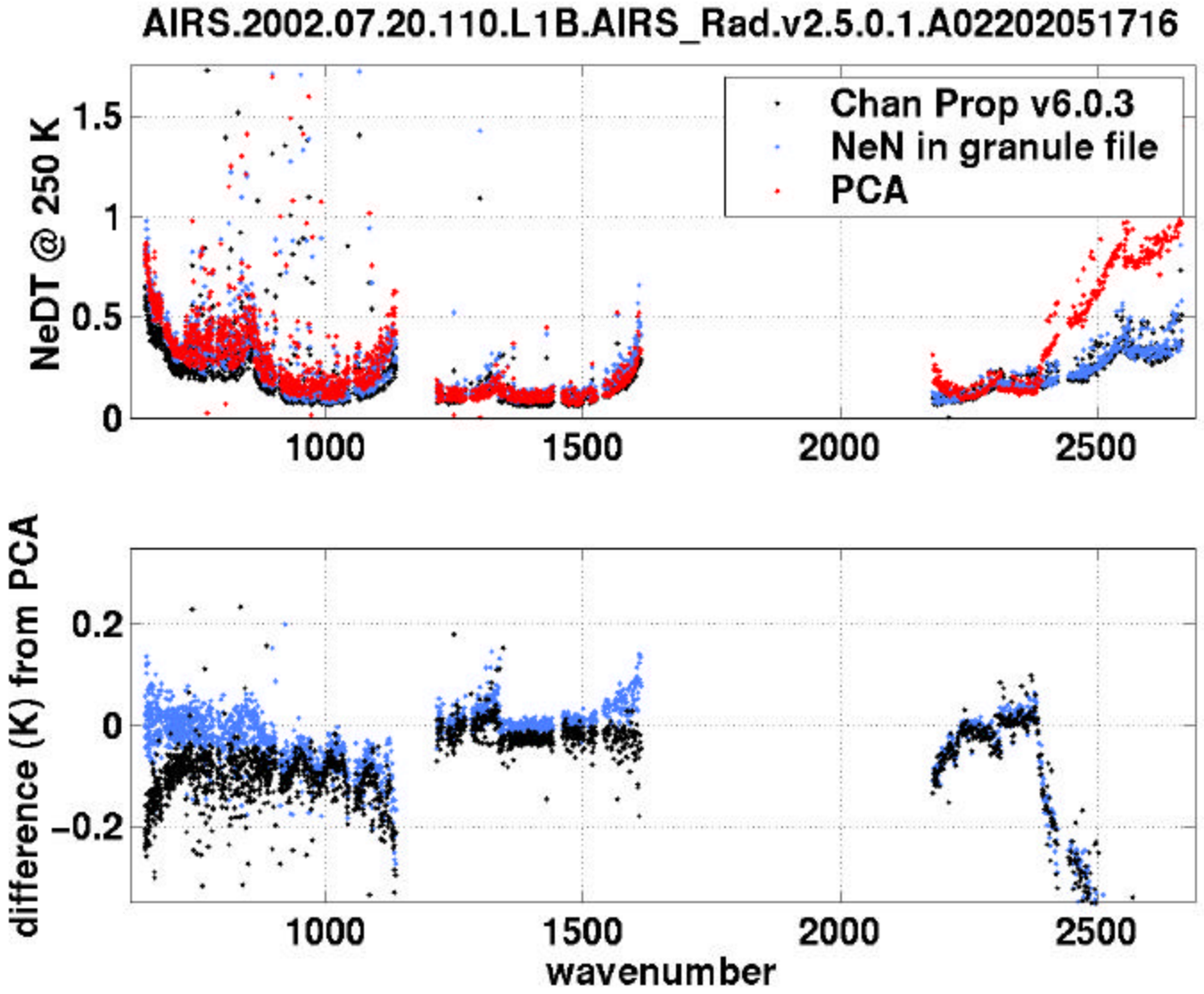
1500
2000
2500
difference (K) from PCA
0.2
0
−0.2
1000
1500
2000
2500
wavenumber

granule 110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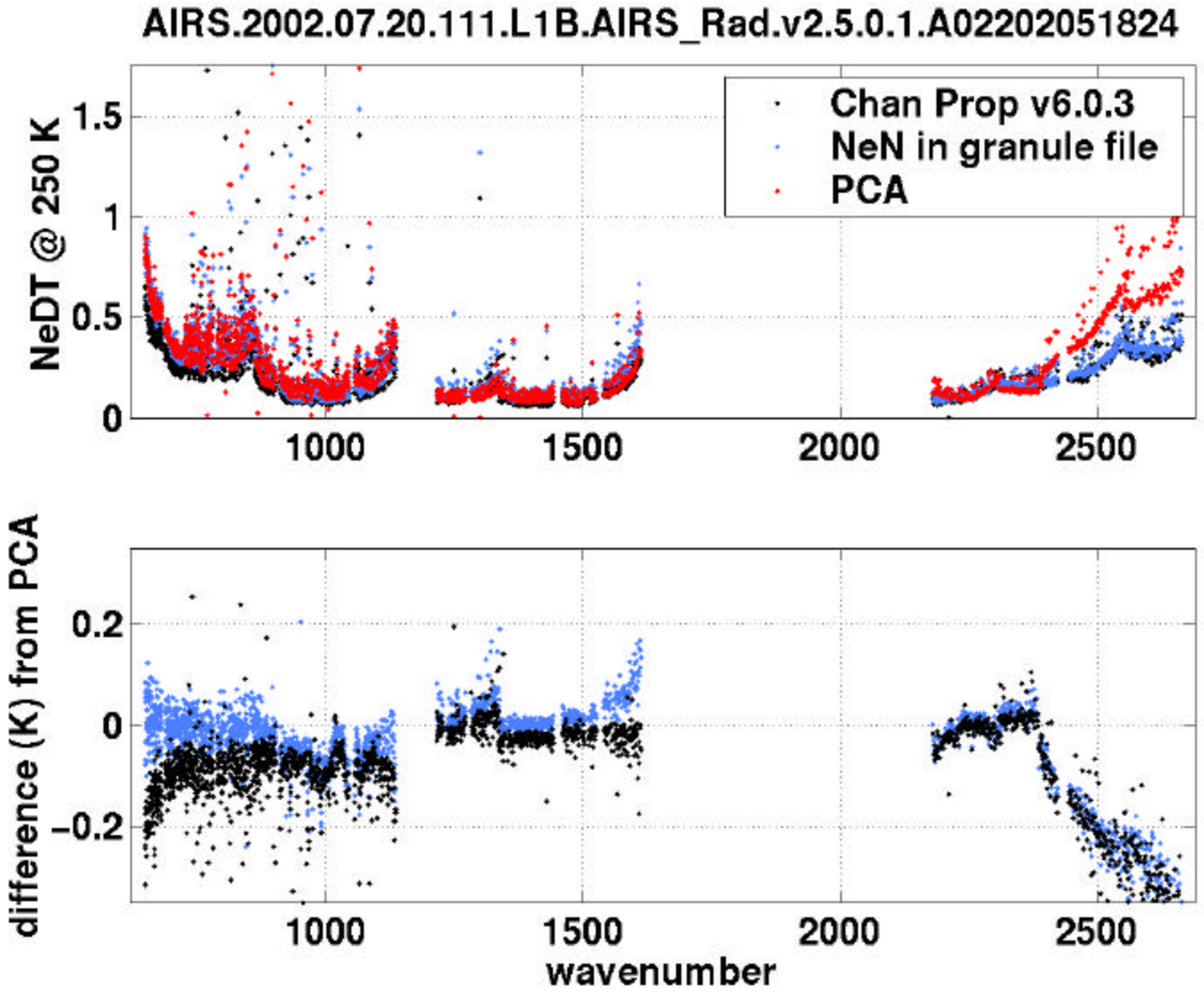
Chan Prop v6.0.3
NeN in granule file
PCA
NeDT @ 250 K
1.5
1
0.5
0
1000
1500
2000
2500
difference (K) from PCA
0.2
0
−0.2
1000
1500
2000
2500
wavenumber

granule 111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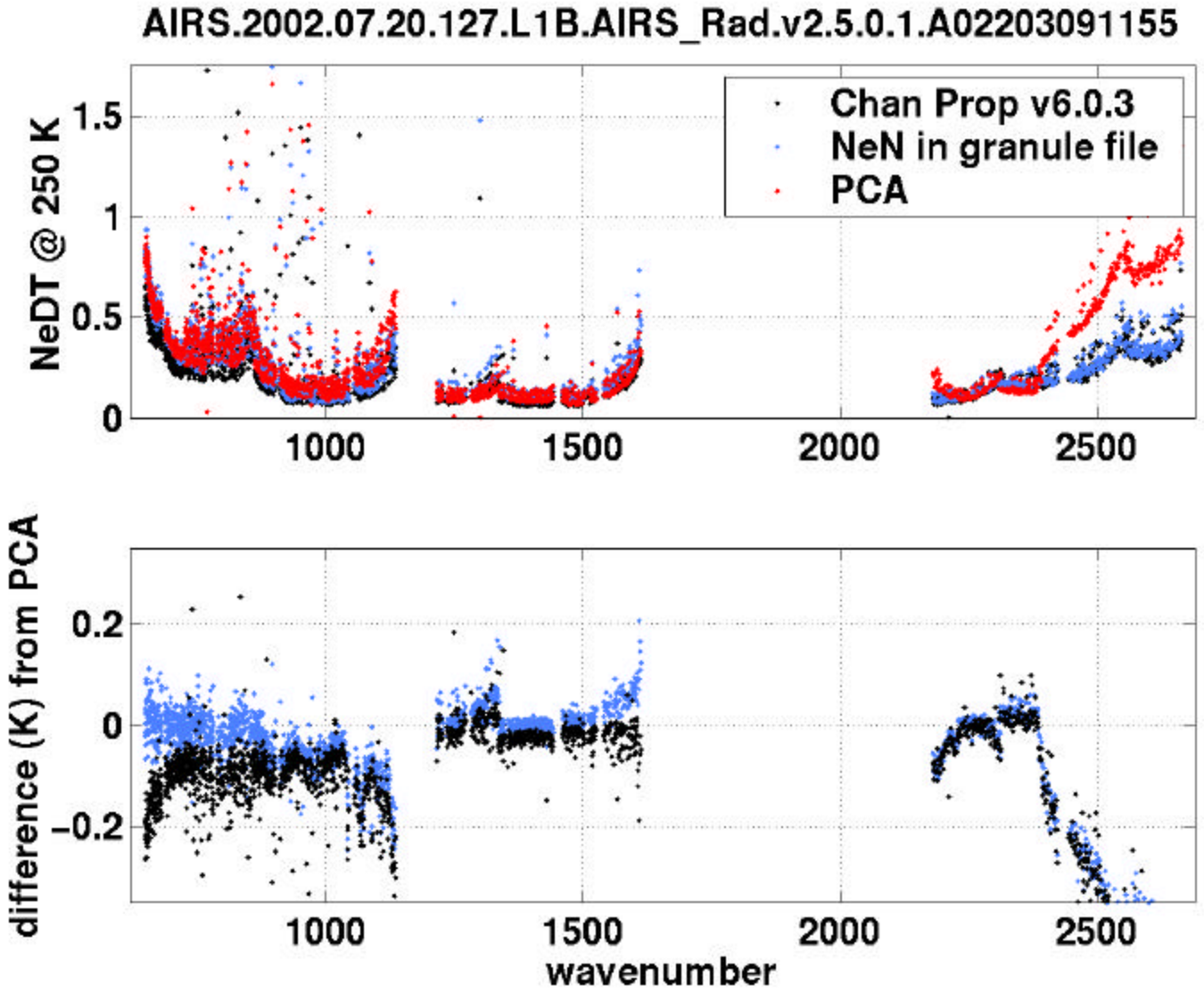
NeN in granule file
PCA
NeDT @ 250 K
1.5
1
0.5
0
1000
1500
2000
2500
difference (K) from PCA
0.2
0
−0.2
1000
1500
2000
2500
wavenumber

granule 127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NeN in granule file
PCA
NeDT @ 250 K
1.5
1
0.5
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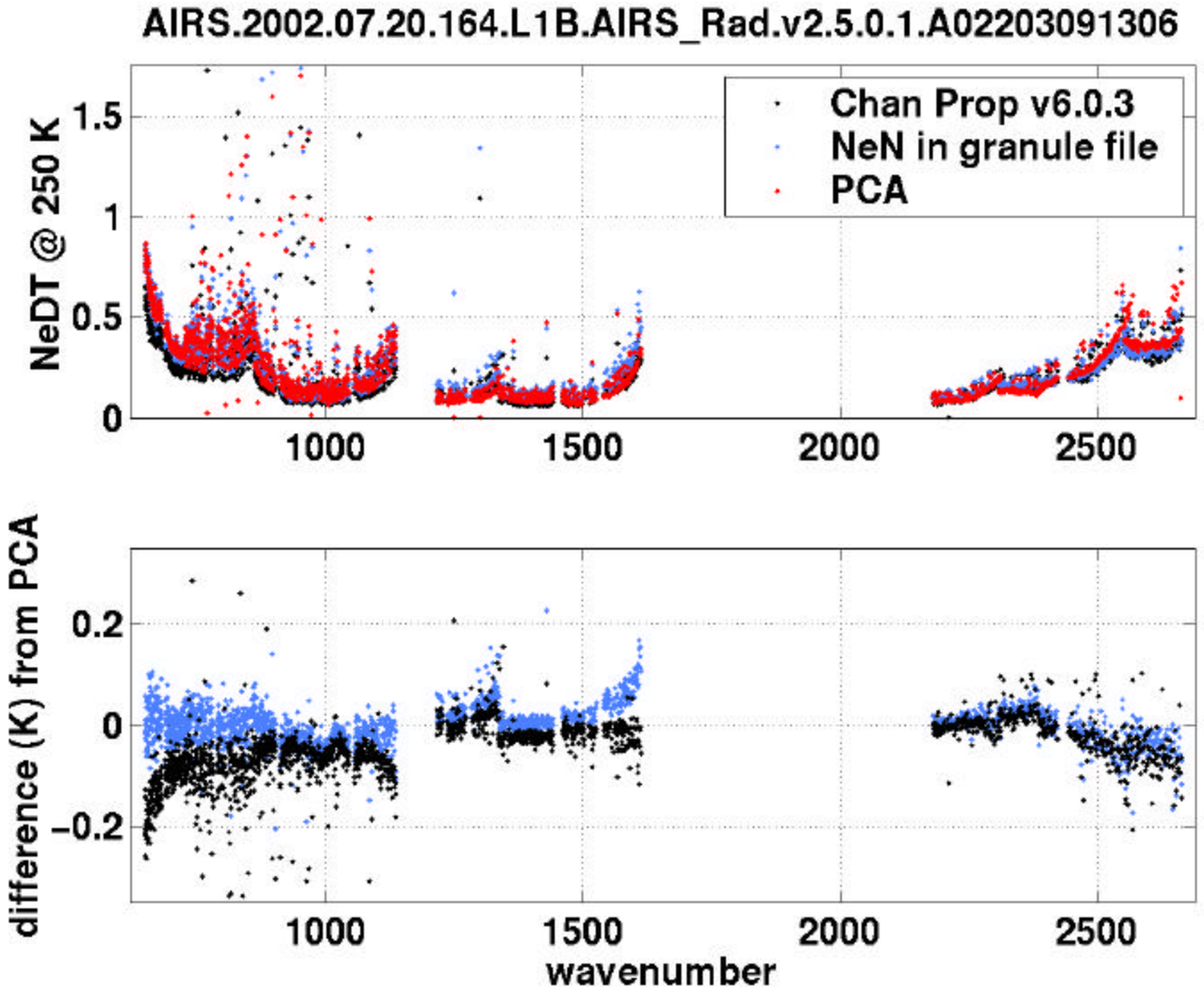
1000
1500
2000
2500
difference (K) from PCA
0.2
0
−0.2
1000
1500
2000
2500
wavenumber

granule 164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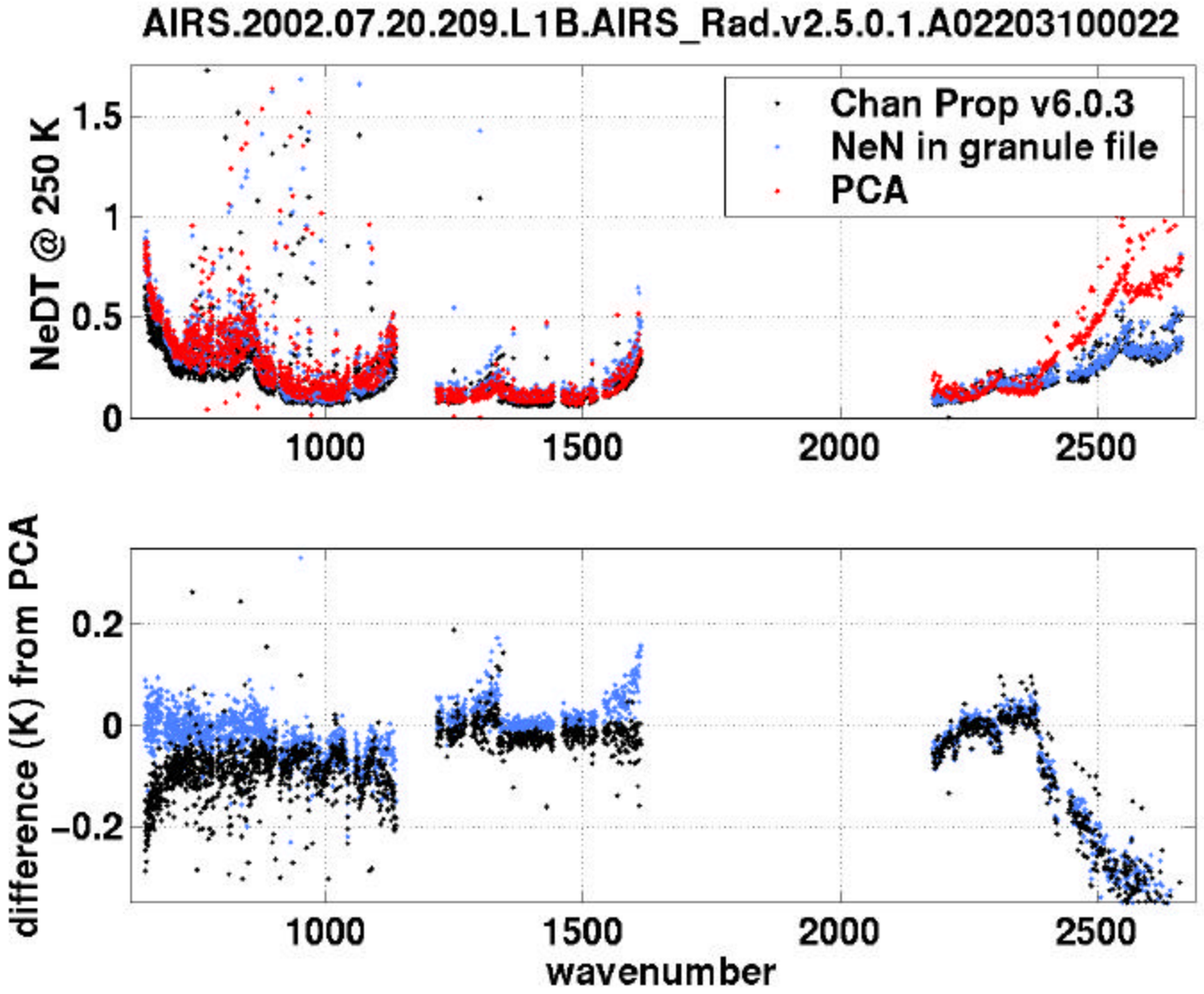
Chan Prop v6.0.3
NeN in granule file
PCA
NeDT @ 250 K
1.5
1
0.5
0
1000
1500
2000
2500
difference (K) from PCA
0.2
0
−0.2
1000
1500
2000
2500
wavenumber

granule 209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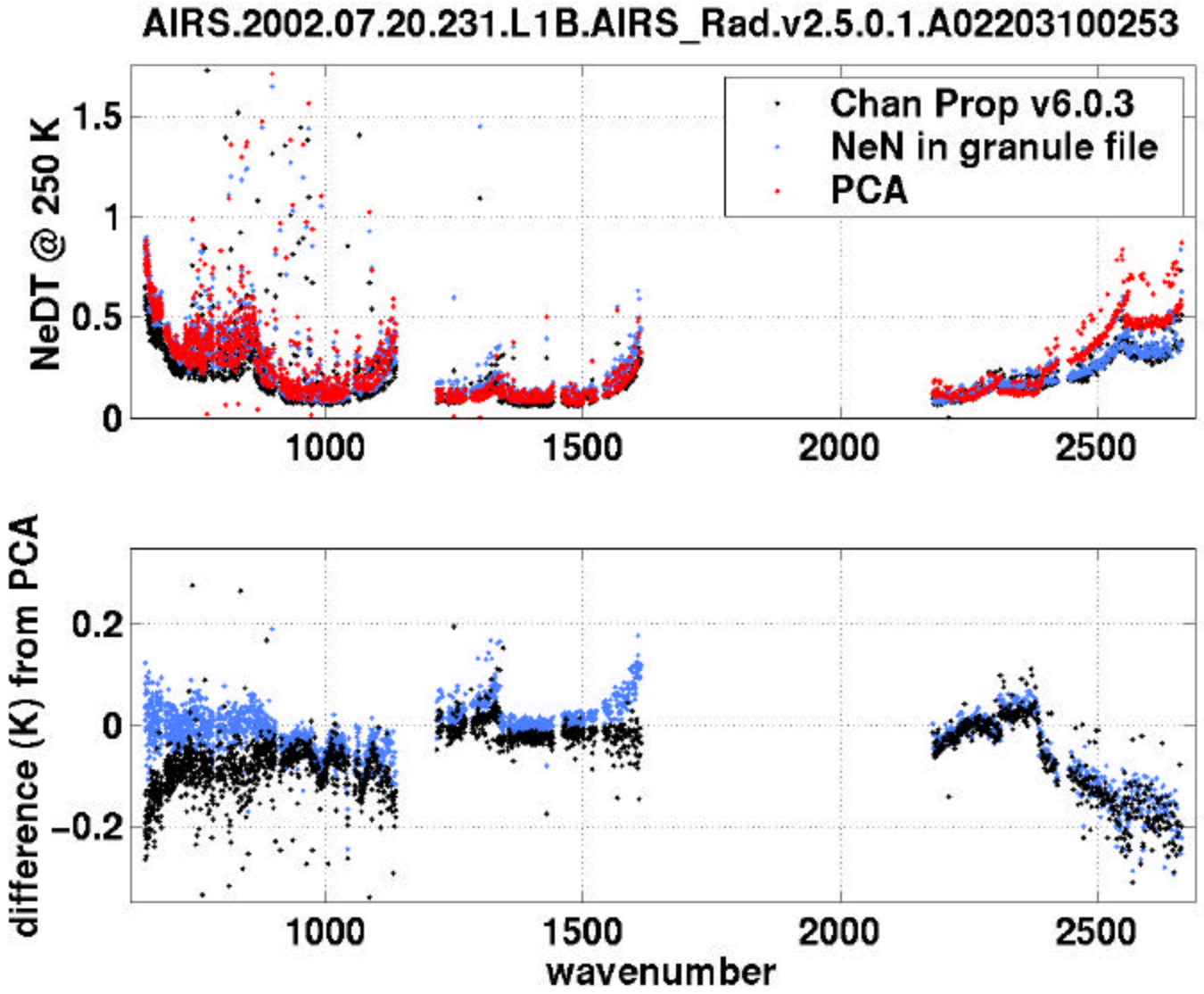
Chan Prop v6.0.3
NeN in granule file
PCA
NeDT @ 250 K
1.5
1
0.5
0
1000
1500
2000
2500
difference (K) from PCA
0.2
0
−0.2
1000
1500
2000
2500
wavenumber

granule 231


AIRS.2002.07.20.231.L1B.AIRS_Rad.v2.5.0.1.A02203100253
Chan Prop v6.0.3
NeN in granule file
PCA
NeDT @ 250 K
1.5
1
0.5
0
1000
1500
2000
2500
difference (K) from PCA
0.2
0
−0.2
1000
1500
2000
2500
wavenumber

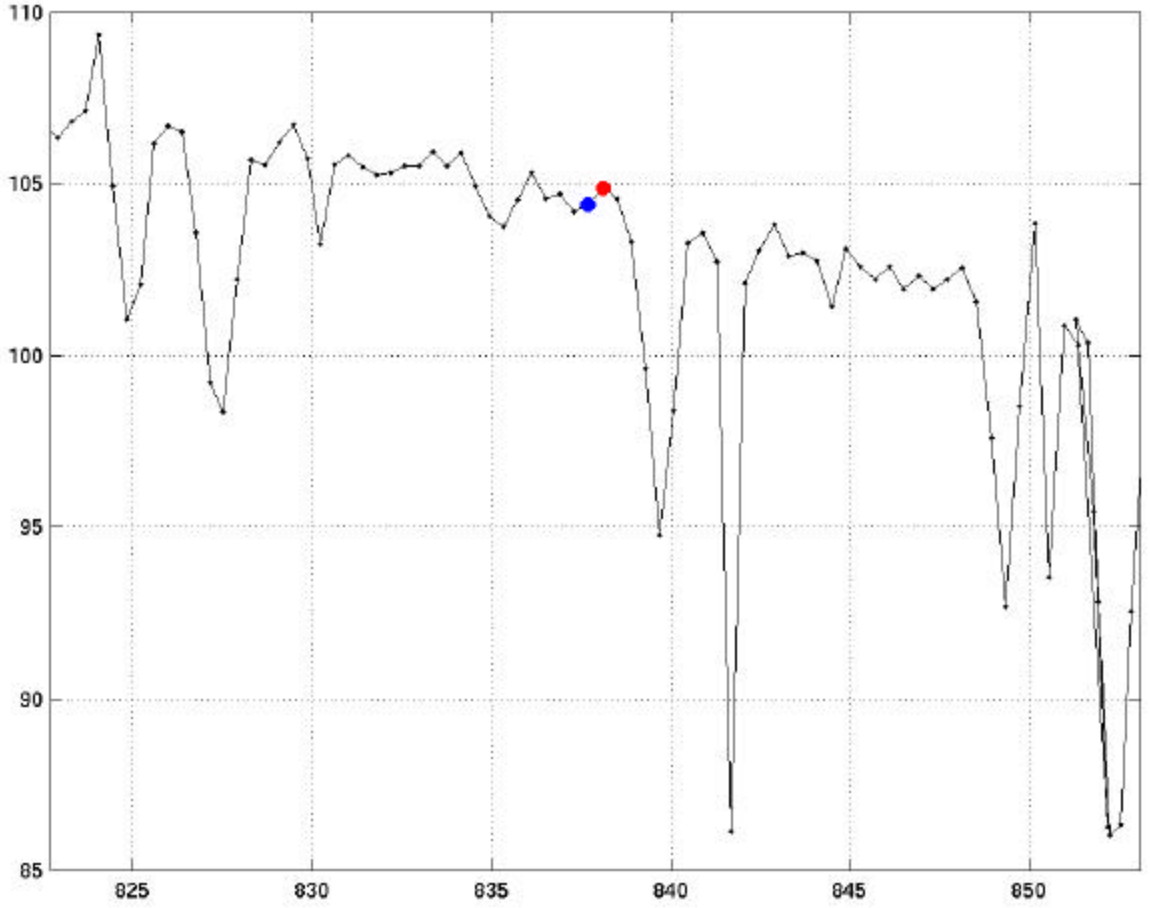
NeDT Estimation using Earth Scene Data

- **Summary**
  - Noise Normalization prior to PCA improves results slightly and will be adopted in the future.
  - LongWave NeDT@250K:
    - PCA results yield best agreement with “NeN” from granule files (order ~0.02 K)
    - PCA results are slightly higher than values provided in v6.0.3 channel properties file (order 0.05 K)
  - MidWave NeDT@250K:
    - PCA results yield good agreement with “NeN” from granule files, but are slightly higher by ~0.03 K.
    - PCA results yield best agreement with values provided in v6.0.3 channel properties file, but are slightly lower by ~0.02 K.
  - ShortWave:
    - photon-limited noise characterized (presented at last Net-Meeting)

Striping/Popping Analysis

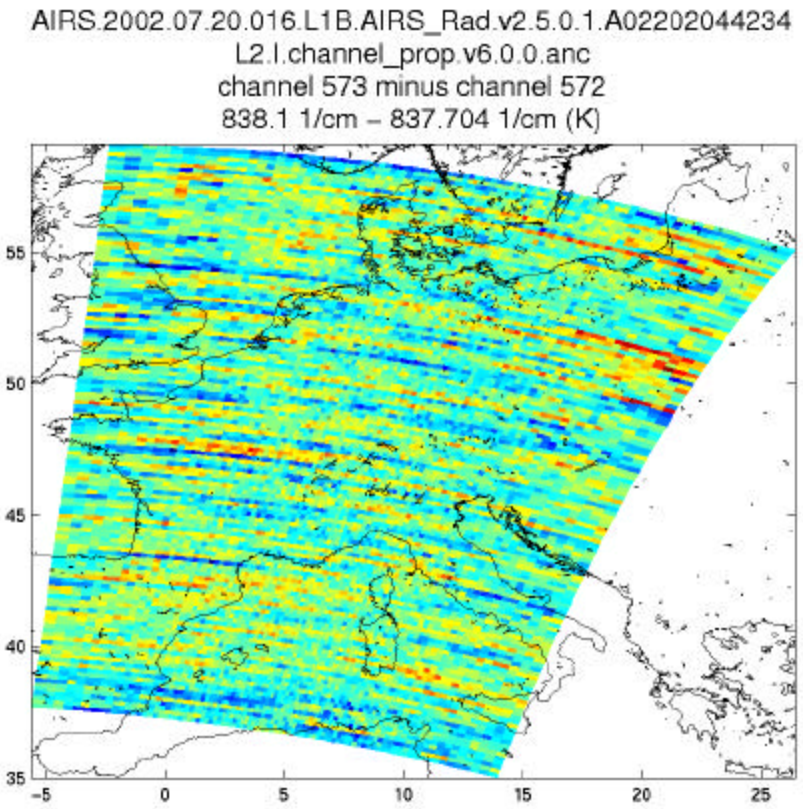
- Residual calibration noise and transient detector behavior ("popping") both contribute to spatial "striping". ("1/F noise" used in our previous analysis and presentation was a mis-nomer).
- Contributions due to the calibration in the 6/14/2002 data have been greatly reduced by use of the L1B ATBD algorithm (using granule mean gains versus scan-line by scan-line gains).
- Residual striping due to detector "popping" is still significant. Order 1K not uncommon for longwave PV detectors, with nearly all demonstrating at least some low level of popping.
- This presentation:
    - Uses channel differences and Dependent Set PCA filter used to characterize residual "striping" in 7/20/2002 granules.
    - Demonstrates that Dependent Set PCA is effective in removing the majority of the residual striping, as well as most of the spatially uncorrelated noise.
- Should perform studies to determine impact on retrievals.

Granule 016
channels 572, 573
AB_State = [0,0], Rad_Qual = [0,0], Bad_Flag = [0,0]

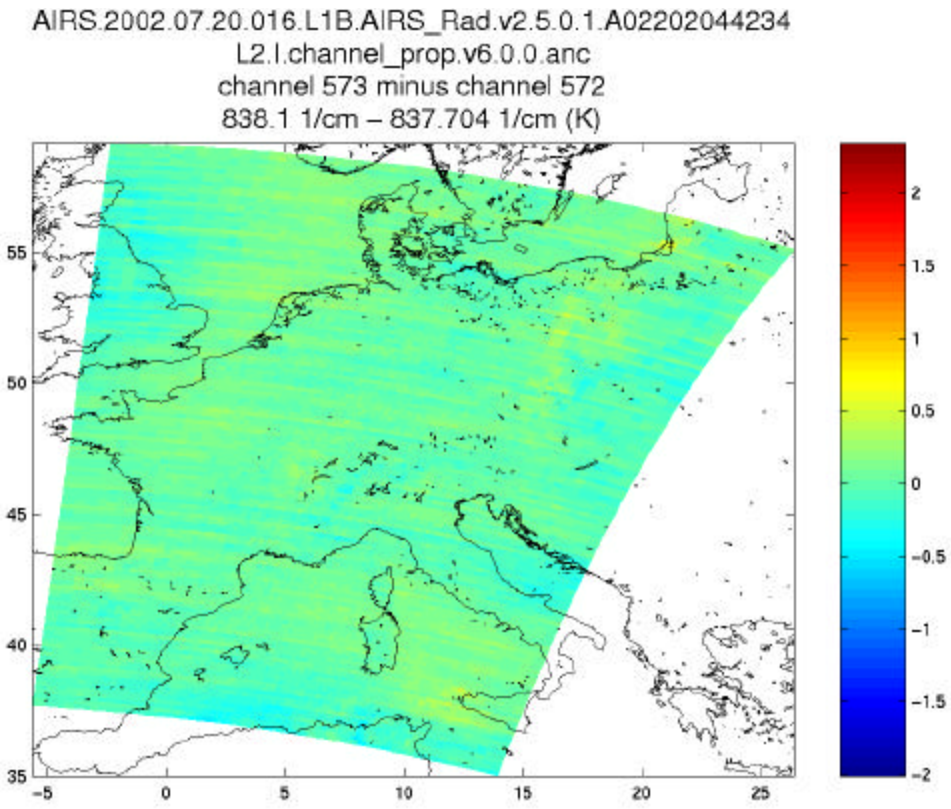


Channel 573 - Channel 572 Brightness Temperature Differences

Original

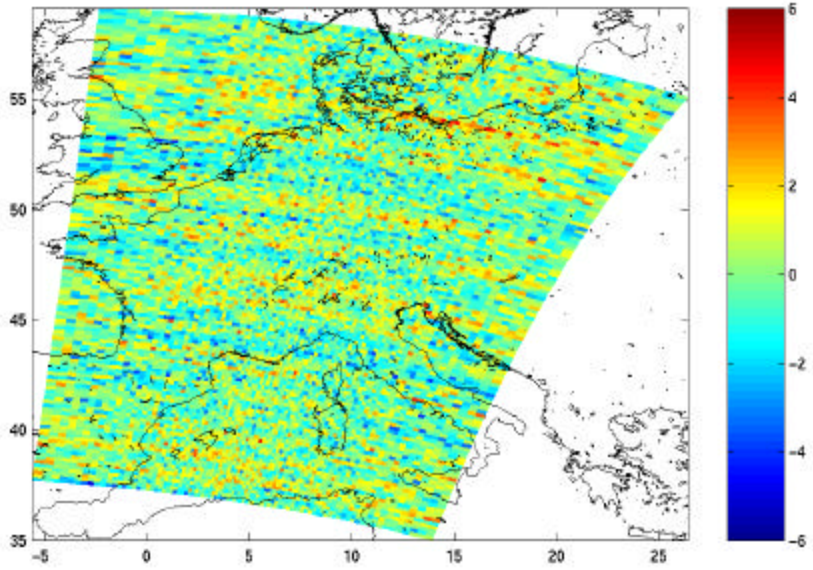


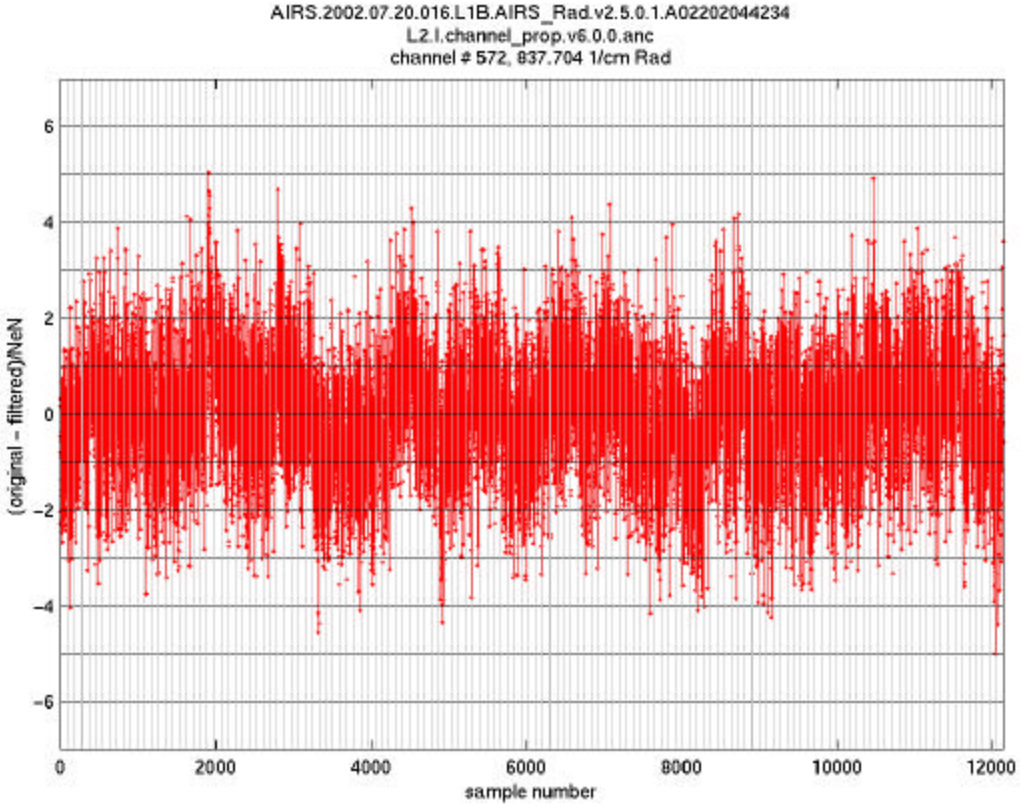
Filtered



Channel # 572

(Original-Filtered)/NeN

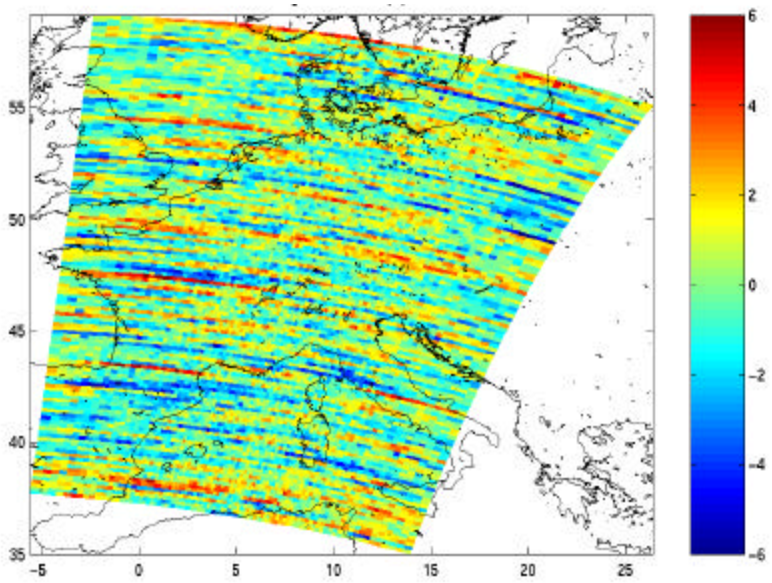


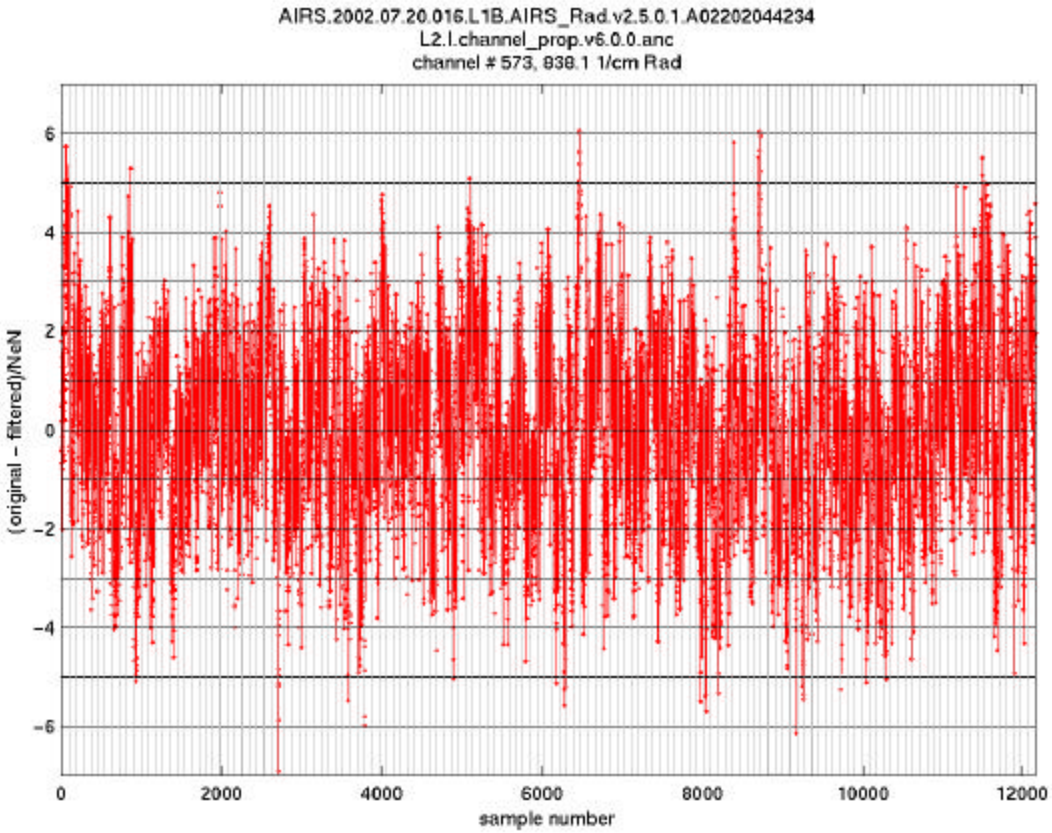


pops: 0 (5σ), 0 (4σ), 0 (3σ), 15 (2σ), 225 (1σ)

Channel # 573

(Original-Filtered)/NeN

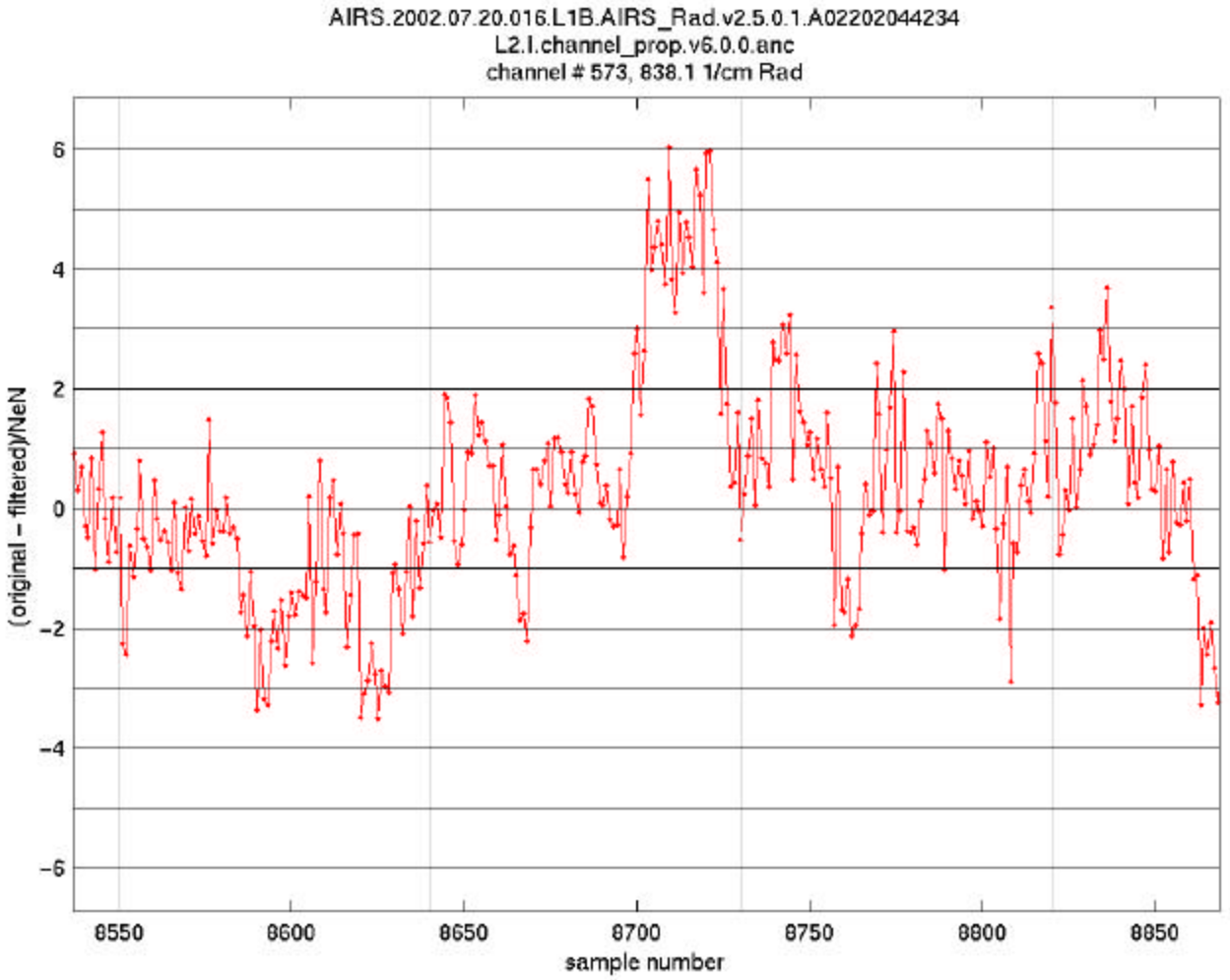




pops: 2 (5σ), 16 (4σ), 91 (3σ), 351 (2σ), 1025 (1σ)

Channel # 573

(Original-Filtered)/NeN



Granule 016
channels 674, 675
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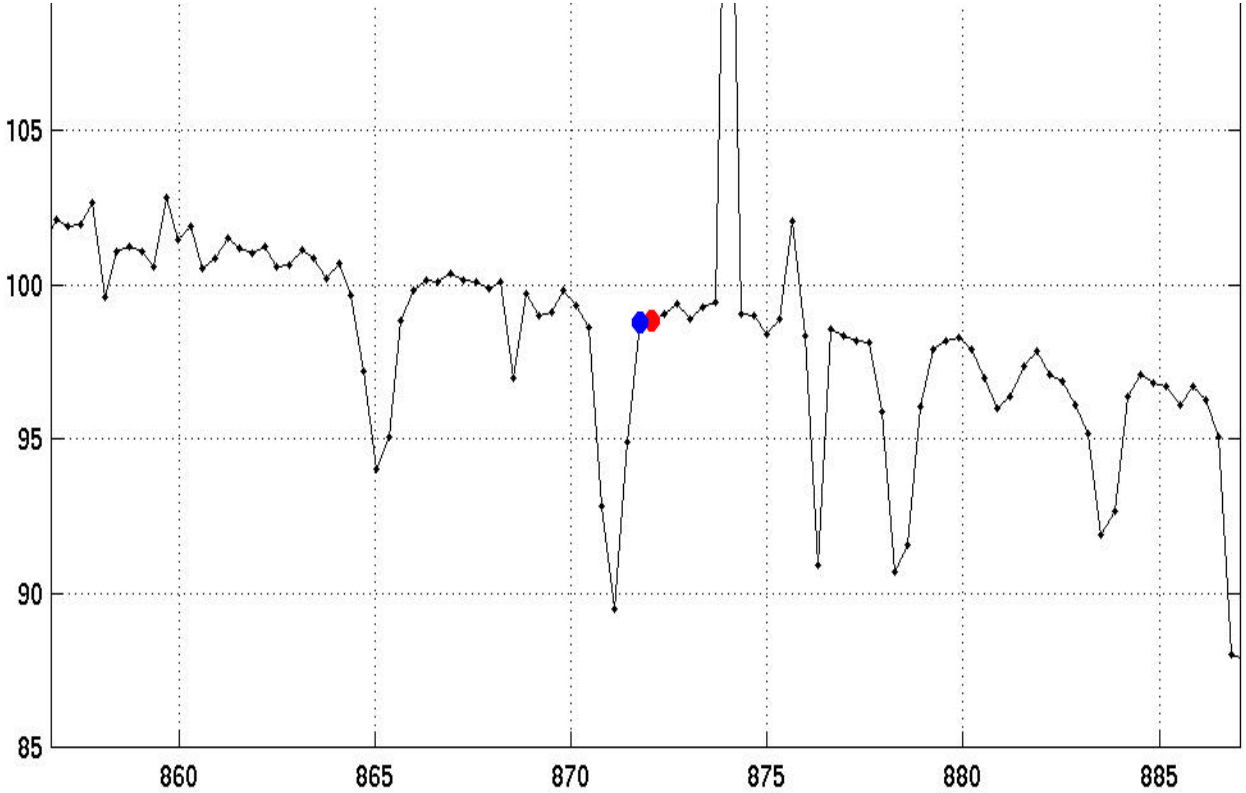
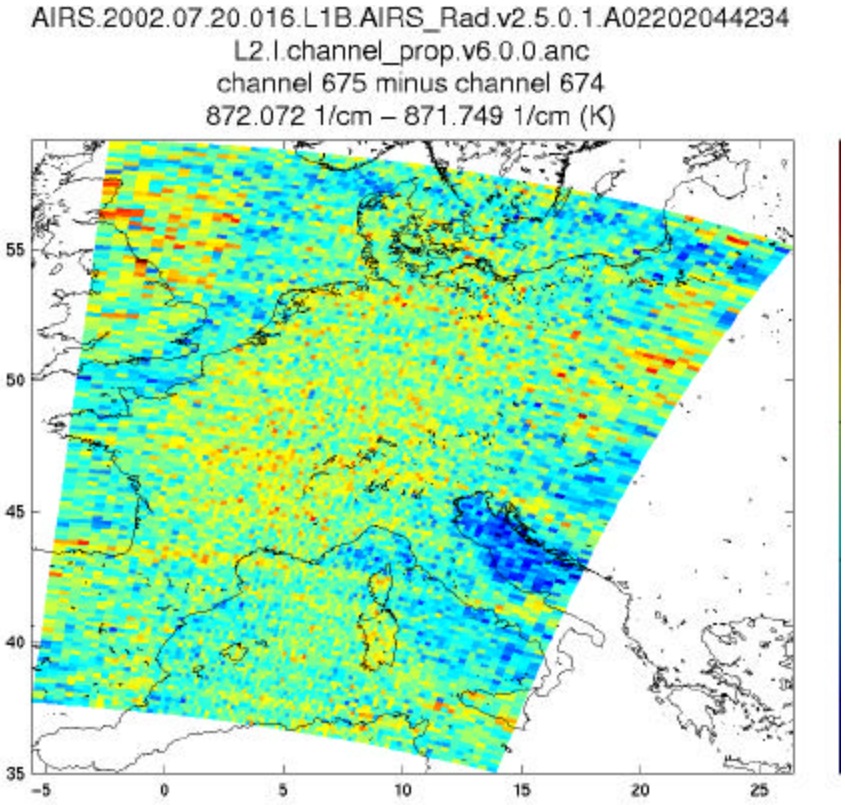
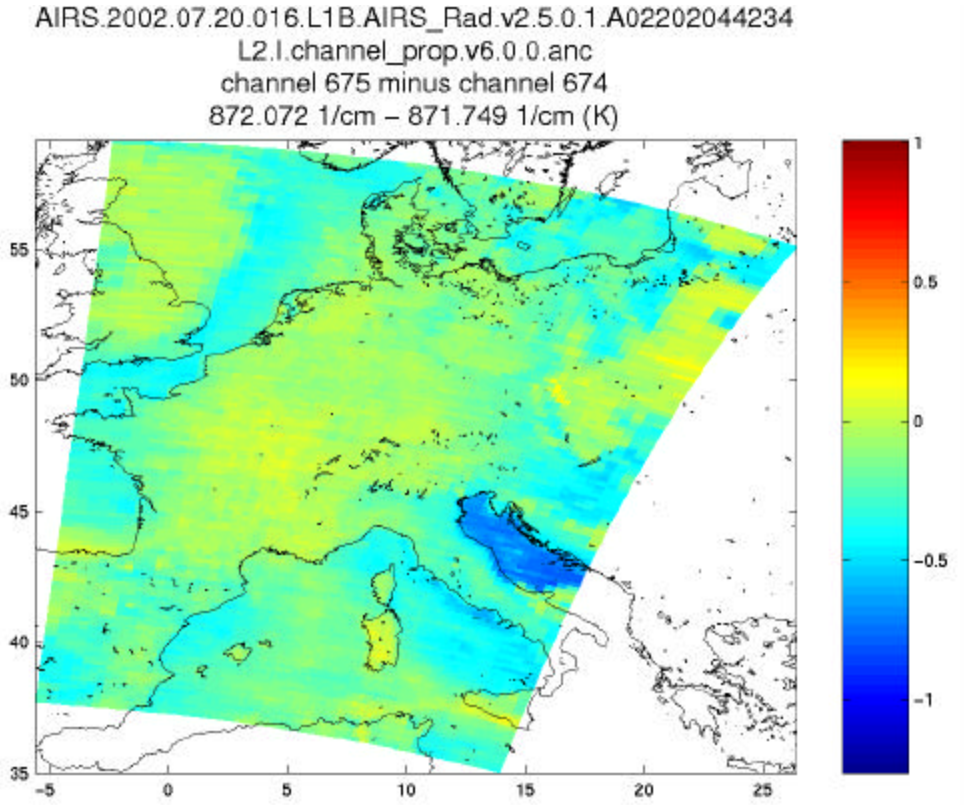


Channel 675 - Channel 674 Brightness Temperature Differences

Original

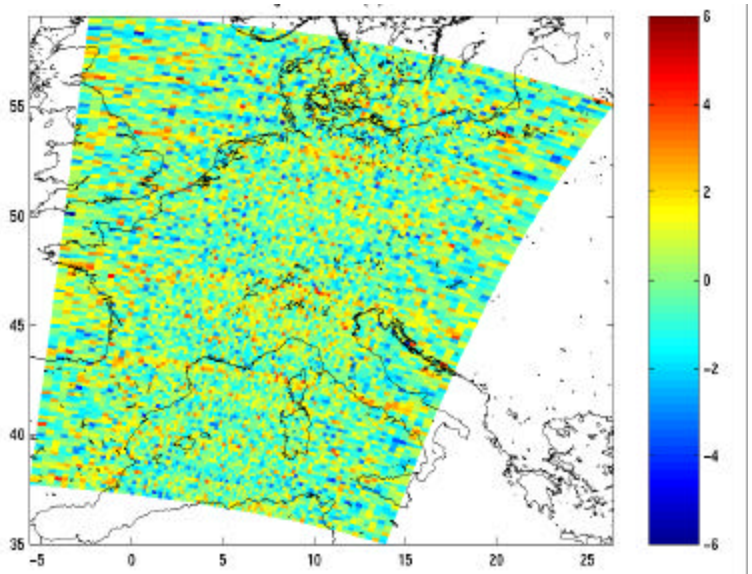


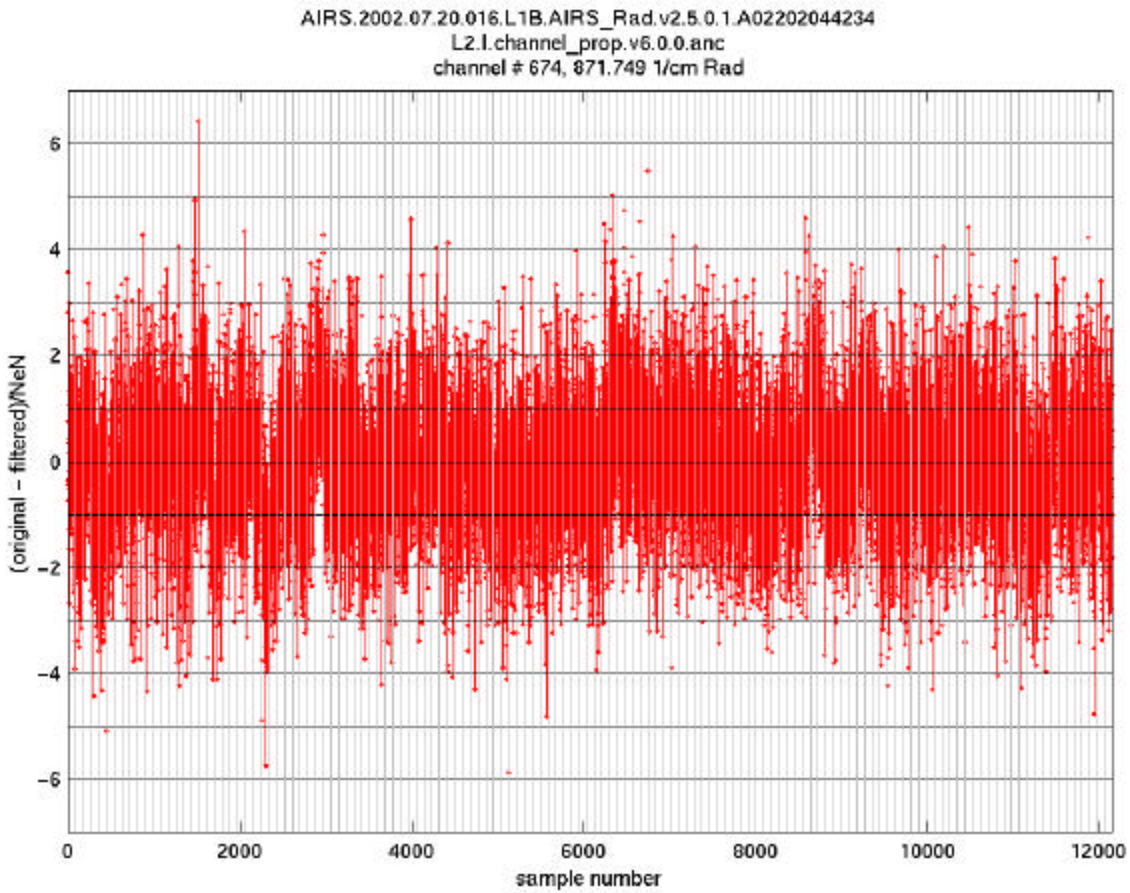
Filtered



Channel # 674

(Original-Filtered)/NeN

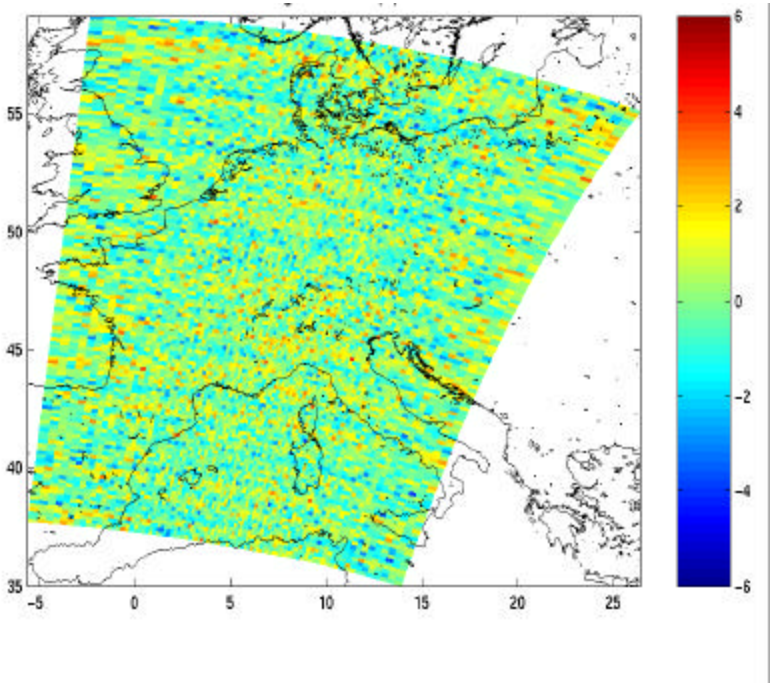


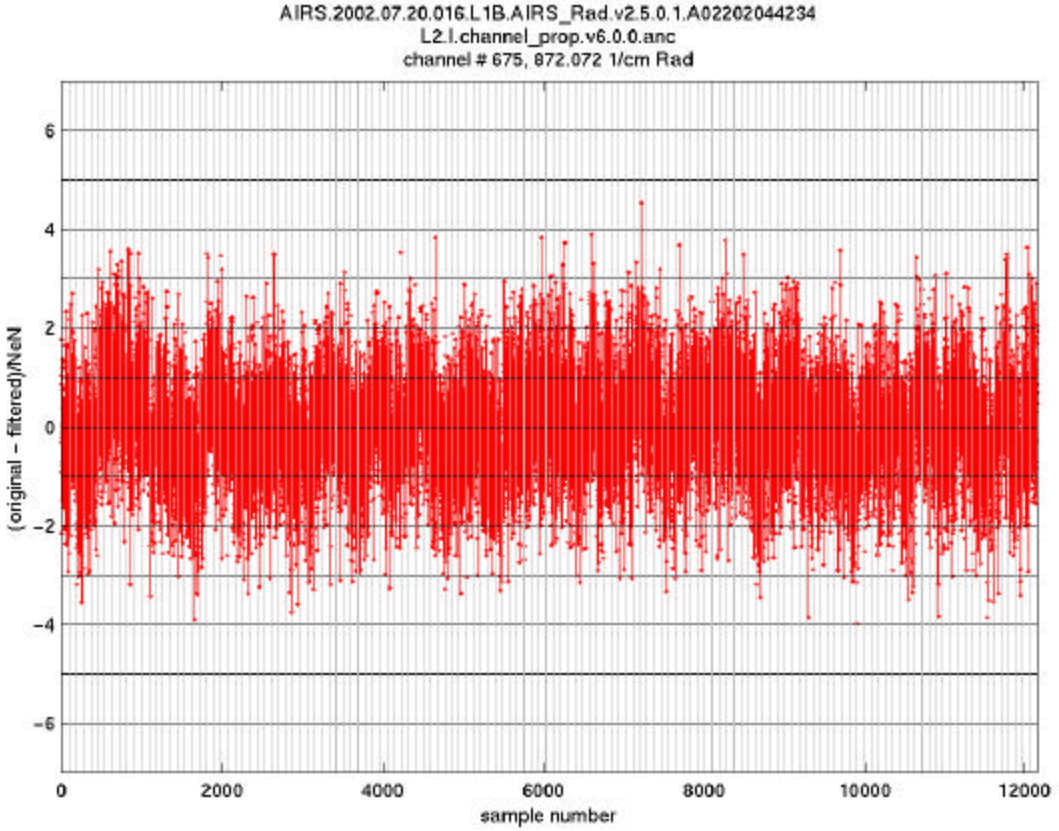


pops: 0 (5σ), 0 (4σ), 0 (3σ), 7 (2σ), 139 (1σ)

Channel # 675

(Original-Filtered)/NeN





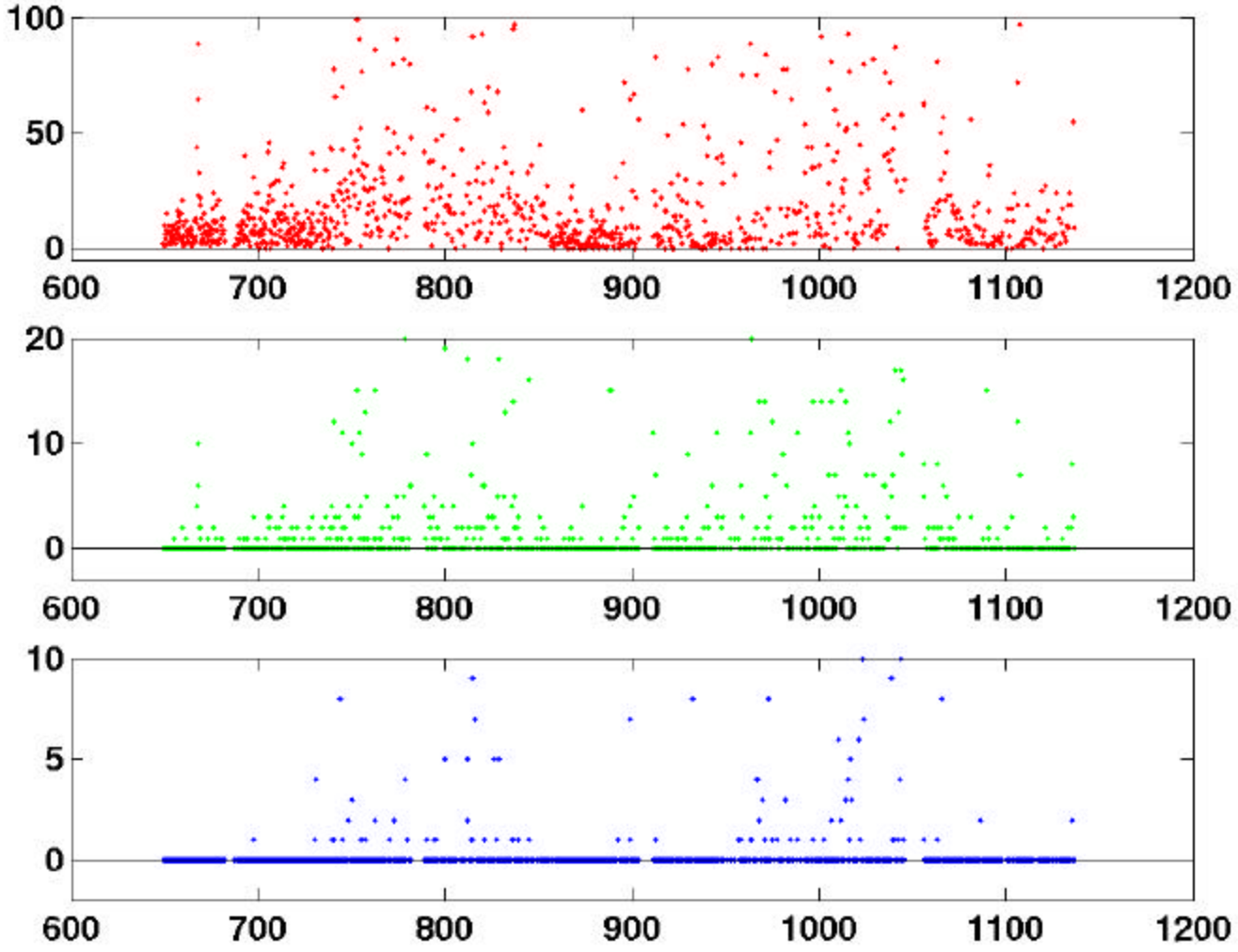
pops: 0 (5σ), 0 (4σ), 0 (3σ), 0 (2σ), 88 (1σ)

Granule 016,
Channels with Bad Flag == 0

2σ pops

3σ pops

4σ pops



wavenumber

Cloud flag, v3

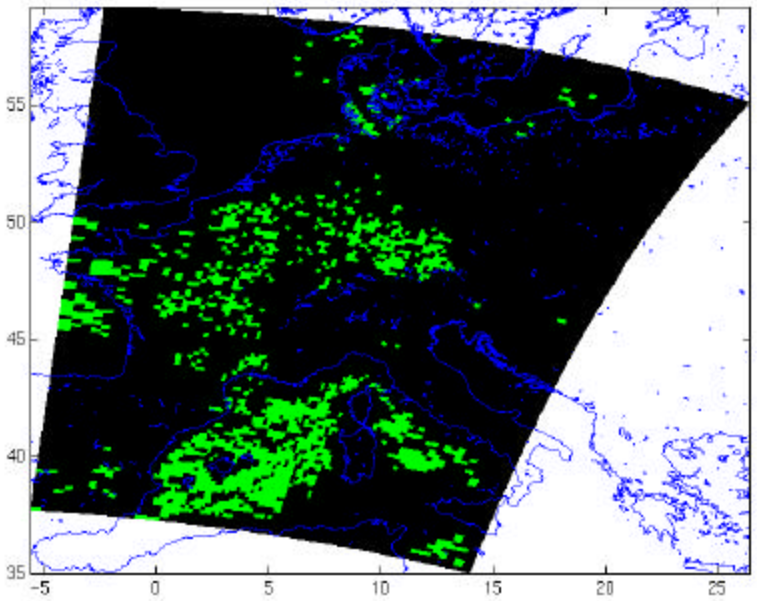
- **Approach:**

  Tb thresholds plus spatial coherence test

  - All FOVs cloudy by default
  - Thresholds: Clear if :
    - Tb(1127 cm^{-1}) > 295K
    - Tb(11.5μm) > 270K & Tb(10.5μm)-Tb(12.5μm) < 3K
    - Tb(offline) - Tb(online) < -0.5 K

      Tb(on-line) = <814-815 cm^{-1} > Tb, Tb(off-line) = <818-822 cm^{-1} > Tb
  - Spatial Coherence:
    - Tb(90,135) = 2616 cm^{-1} and 1125 cm^{-1} brightness temperature images
    - Cloudy if | Tb(I,J) - Tb(I,J+n) | > 1.5n or |Tb(I,J) - Tb(I+n,J)| > 1.5n, n = 1:10
    - Cloudy if | Tb(I,J) - Tb(I,J+1) | > 0.25 or |Tb(I,J) - Tb(I+1,J)| > 0.25
  - Cloudy if Tb_1125 < 270

016



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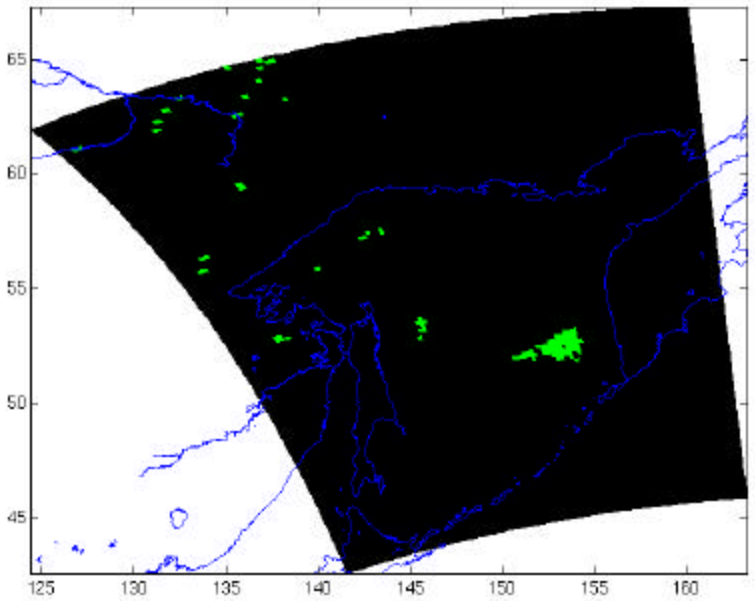

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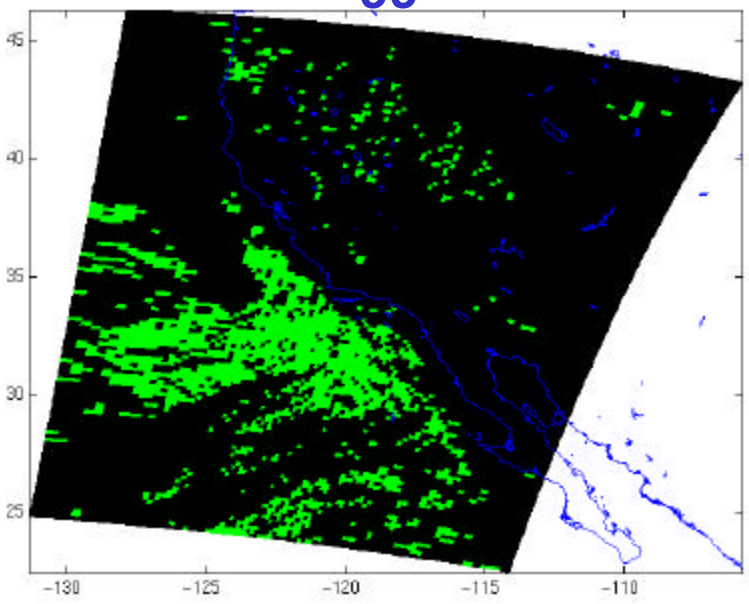

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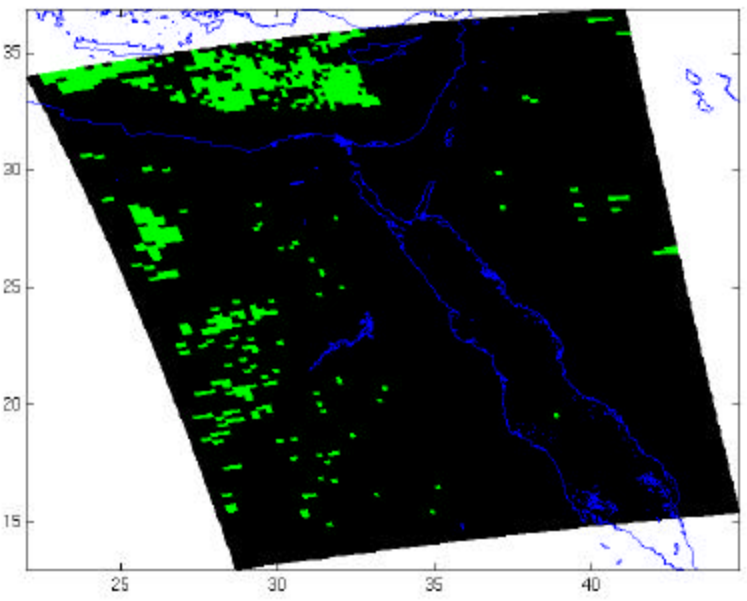

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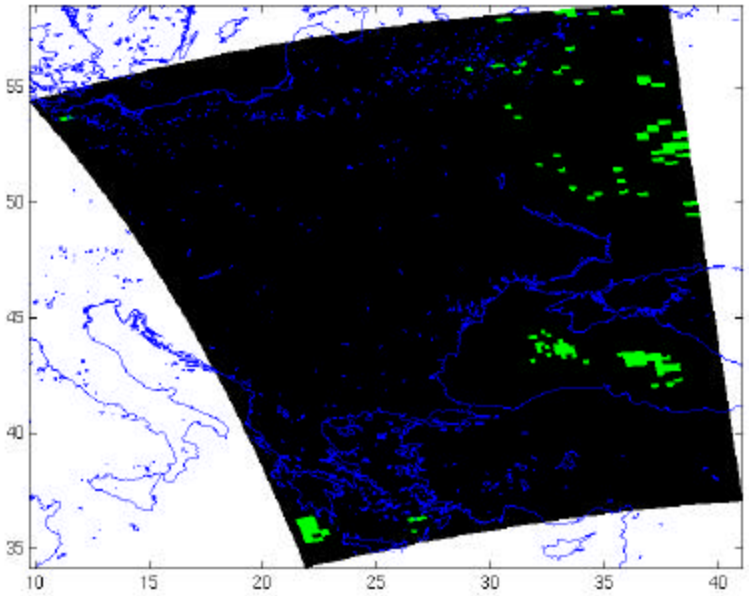

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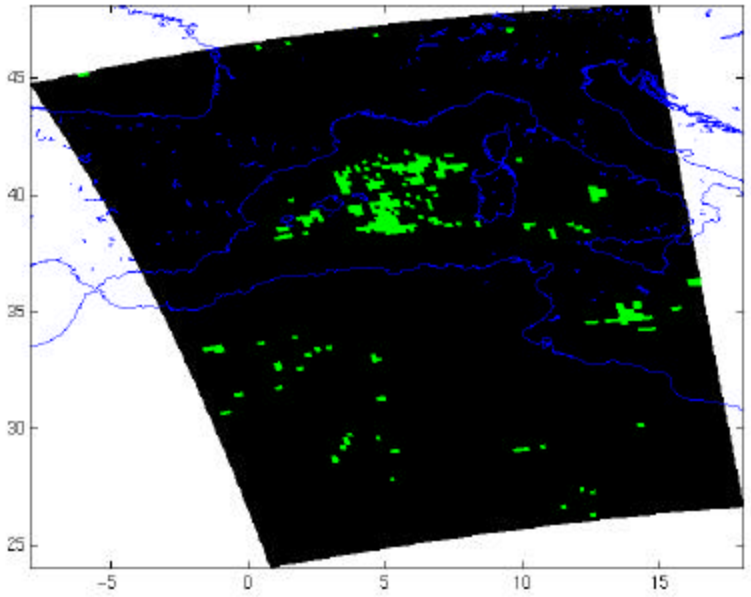

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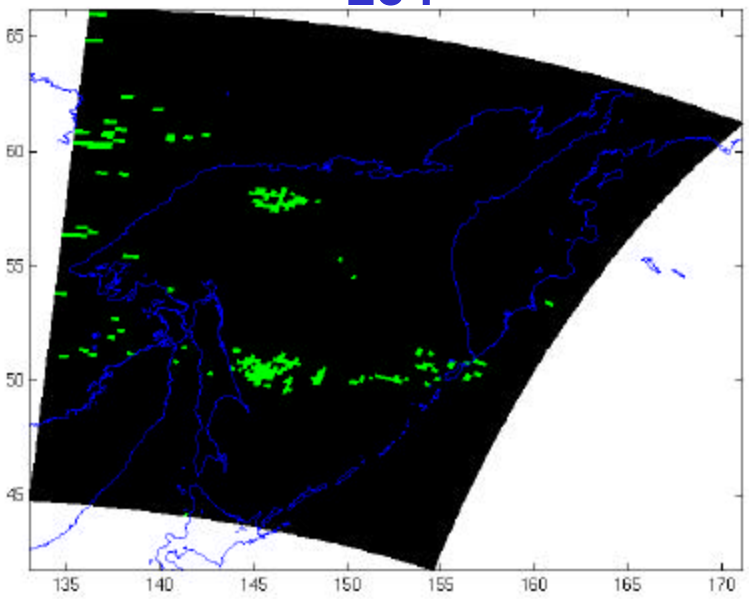

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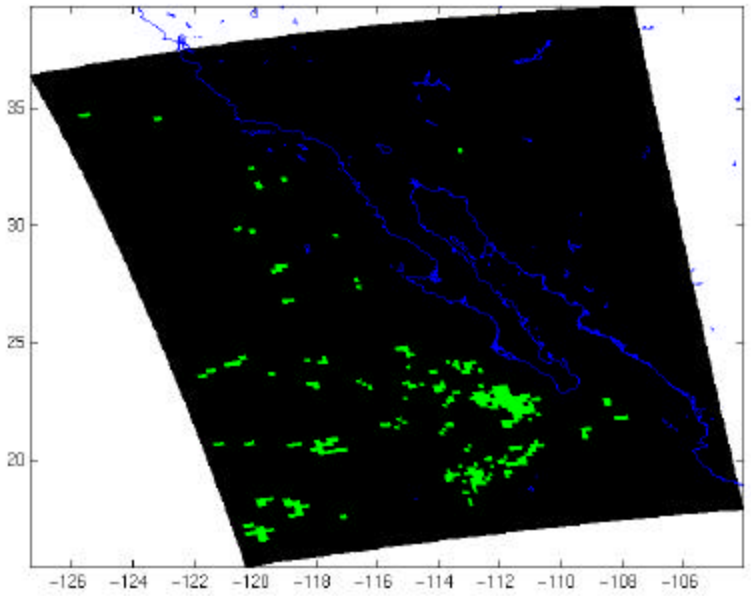
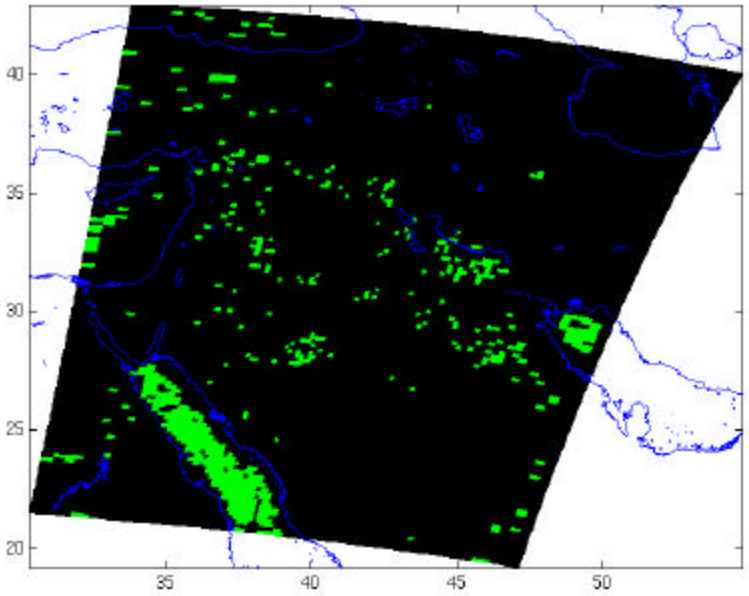
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